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INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P200200582 WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/DK 03/00222	International filing date (day/month/year) 02.04.2003	Priority date (day/month/year) 15.04.2002
International Patent Classification (IPC) or both national classification and IPC G01N21/55		
Applicant DELTA DANSK ELEKTRONIK, LYS & AKUSTIK and al.		

1. This International preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 9 sheets, including this cover sheet.
- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
- These annexes consist of a total of 7 sheets.

3. This report contains indications relating to the following items:
- I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☒ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 05.11.2003	Date of completion of this report 16.07.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Verdoordt, E Telephone No. +31 70 340-3577 

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International application No. PCT/DK 03/00222

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*):

Description, Pages

1-28 as originally filed

Claims, Numbers

17-27 as originally filed

1-16 received on 29.06.2004 with letter of 25.06.2004

Drawings, Sheets

1/6-6/6 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).
- (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:

- ☐ restricted the claims.
- ☒ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
- ☒ not complied with for the following reasons:

see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.
- ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-15,22-27
	No: Claims	16-21
Inventive step (IS)	Yes: Claims	1-15,22-27
	No: Claims	16-21
Industrial applicability (IA)	Yes: Claims	1-27
	No: Claims	

2. Citations and explanations

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see separate sheet

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Reference is made to the following documents:

- D1: DELTA: "On site quality control of road markings & road surfaces in accordance with CEN specifications" LTL2000 RETROMETER, MANUAL, [Online] 11 March 1999 (1999-03-11), pages 1-49, XP002225022 Retrieved from the Internet: URL: http://www.delta.dk/services/products/road-test-equip/04_manua/ltl2000/manua_uk.pdf [retrieved on 2002-11-24]
- D2: WO 97/27470 A (DELTA LYS & OPTIK; NIELSEN HANS OLE (DK); HANSEN JAN HARRIES (DK)) 31 July 1997 (1997-07-31)
- D3: US-A-5 839 812 (GE XIAOQIN ET AL) 24 November 1998 (1998-11-24)

Re Item IV

Lack of unity of invention

1.1 The separate inventions are:

1. Claims 1-15,22,24-27

Apparatus for measuring light reflections of an object

2. Claims 16-21,23

Diffuser light-source assembly

1.2 They are not so linked as to form a single general inventive concept (Rule 13.1 PCT) for the following reasons:

The prior art has been identified as the following document: D1 (see especially page 48).

1.3 From the comparison of claim 1-15,22,24-27 the following technical features can be seen to make a contribution over this prior art (Special Technical Features, Rule 13(2) PCT): a lens arranged so that the illumination beam and observation beam overlap therein, and
a wall member extending only a part of the distance between the observation light receiver and the lens.

1.4 From the first STF the objective problem 1 to be solved by the first invention can be seen in how to provide an increased effective measuring signal. (See also description page 16, lines 15-29)

1.5 From the comparison of claims 16-21,23 the following feature can be seen to make a contribution over this same prior art: the whole diffuser light-source assembly of claim 16.

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- 1.6 From this the STF the objective problem 2 to be solved can be seen in how to produce diffused illumination. (See also description page 26, lines 15-19)
- 1.7 The above analysis shows that the Special Technical Features of invention 1 are not the same or similar to those of invention 2.
- 1.8 A comparison of the objective problem 1 with objective problem 2, both seen in the light of the description and the drawings of the present application, indicates that there is no technical correspondence between these problems nor do they show any corresponding technical effect, so that the STF of invention 2 fails to demonstrate a correspondence with the STF of invention 1 as required by Rules 13.1 and 13.2 PCT.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

FIRST INVENTION: Claims 1-15,22,24-27

NOVELTY

- 2.1 The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (see especially page 1 and 48) the preamble of claim 1 in case the observation aperture of D1 is considered as the first observation field stop adapted to define a ray boundary.
- 2.2 The subject-matter of claim 1 differs from this known apparatus for measuring light reflections in the features of the characterizing portion of claim 1, that is that the lens is arranged so that said illumination beam and said observation beam form an overlap therein; and that said first observation field stop comprises a wall member extending from the observation light receiver towards said lens; wherein the wall member extends only a part of the distance between the observation light receiver and the lens as to limit said ray boundary of said observation beam while maintaining said overlap of said illumination beam and said observation beam inside the lens.
- 2.3 The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

INVENTIVE STEP

- 3.1 The problem to be solved by the present invention may be regarded as how to provide an increased effective measuring signal and prevent stray light from the illumination light source reaching the observation light receiver.
- 3.2 The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
Even though document D2 (Page 2, lines 23-24; figure 1 and 2) and the prior art sketched in figure 2 of the present application show that the loss of effective measuring signal can be reduced by removing the beam splitter and letting the beams overlap in the lens, they do not show the use of a wall extending only a part of the distance from the observation light receiver towards said lens.
- 3.3 Although document D1 shows a wall extending all the way from the observation light receiver towards the lens, it does not give a hint for a reduced wall, nor does any other of the prior art documents.
- 3.4 Claims 2-15 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.
- 3.5 It appears that the thin line in Figure 4 of D2 could be interpreted as being a wall which extends only a part of the distance between the observation light receiver and the lens as to limit the ray boundary of the observation beam while maintaining the overlap of the illumination beam and observation beam inside the lens. However, there is no strong indication in the description of D2 that this line really is a wall or is meant to have the purpose of limiting the ray boundary as the diaphragm is already used for limiting the ray boundary. Further it could be argued that this wall does not really extend from the observation light receiver towards said lens. Document D2 therefore has not been taken further into consideration when assessing novelty of amended claim 1.
- Claims 22, 24 and 25
- 3.6 The application does not meet the requirements of Article 6 PCT, because dependent claims 22 and 25 are not clear.
- 3.7 Claims 22 and 25 refer to a "light source illumination-observation assembly as defined in claims 3-15". However, none of these claims explicitly mention this

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assembly, although it is obvious that the illumination unit and the observation unit as referred to in claim 3 are to be seen as the components with which such an assembly could be composed.

- 3.8 In case dependent claims 22 and 25 are understood as explained above, claims 22, 24 and 25 appear to meet the requirements of the PCT with respect to novelty and inventive step as independent claim 1 and dependent claims 3-15, on which they depend, are also new and inventive.

Independent claim 26

- 3.9 Independent claim 26 is about the use of an apparatus in any of claims 22-25. Claims 22 and 24 appear new and inventive as explained under 3.7 and 3.8. Claim 26 is therefore also new and inventive in the sense of Articles 33(2) and 33(3) PCT.
- 3.10 Claim 27 is dependent on claim 26 and as such also meets the requirements of the PCT with respect to novelty and inventive step.

SECOND INVENTION: Claims 16-21

Independent claim 16

- 4.1 The subject-matter of claim 16 is not new in the sense of Article 33(2) PCT, and therefore the criteria of Article 33(1) PCT are not met.
- 4.2 The document D3 discloses (the references in parentheses applying to this document):
A diffuser light-source assembly, the assembly comprising:
(A) a light source (301); and
(B) a diffuser (303) with a cavity wall, said diffuser comprising:
(a) a diffusive reflecting cavity wall (304; see also col. 5 lines 2-5), said diffusive reflecting cavity wall comprising partly or wholly reflective surface elements, providing multiple reflections of said light received through a light receiving aperture, and
(b) a plurality of light emitting apertures (307; see also col. 4 lines 48-56 and figure 4), said light emitting apertures being arranged in said cavity wall characterized in that said light emitting apertures are adapted to emit diffused light.

4.3 Although document D3 is about a parallel light source to be used for e.g. back reflection screens, it is only due to the cones and lenses above the small holes (see figure 4 and 5) that the light rays become parallel. The small holes (307) however, do emit diffused light, that is, with a certain variety of exit angles. Furthermore, claim 16 does not talk about a diffusive light source, but about a diffuser AND a light-source assembly, which is also to be found in D3.

4.4 Claim 16 is therefore not new.

Dependent claims 17-21

4.5 Dependent claims 17-21 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

4.6 **Claim 17:** the light emitting apertures in document D3 constitute certainly less than 20% of the cavity wall.

4.7 **Claim 18:** D3 also shows the light receiving aperture adapted to receive light from the light source.

4.8 **Claim 19:** The interior surface of the diffuse reflective chamber in D3 is made of a high reflectance diffuse reflection layer (see col. 5, lines 2-4). The skilled person understands that this may be a white finish.

4.9 **Claim 20:** The diffuser in D3 shows the same features concerning the shape as claim 20.

4.10 **Claim 21** does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is **not clearly defined**. The claim attempts to define the subject-matter in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result. The skilled person would have to perform experiments to find out which thicknesses comply with the sought conditions. The above-mentioned lack of clarity notwithstanding, the perforated plate in D3 seems to be thin enough in order to maintain conditions of diffused light emitted from the apertures.

Dependent claim 23

4.11 Claim 23 is dependent on claim 22 and as such also meets the requirements of the PCT with respect to novelty and inventive step in case point 3.8 is taken into account.

29.06.2004

METHOD AND APPARATUS FOR MEASURING LIGHT REFLECTIONS
AN OBJECT

(96)
OF5 CLAIMS

1. An apparatus for measuring light reflections of an object, the apparatus comprising:

10 (A) an illumination unit for providing an illumination beam (305), said illumination beam illuminating an illumination field (313) on the object;

15 (B) an observation unit for providing an observation beam (306), said observation beam comprising light received from an observation field on said illuminated object; said observation unit comprising at least a first observation field stop (310) adapted to define a ray boundary of said observation beam (306);

20 the observation unit further comprising an observation light receiver (302, 304) adapted to provide a measuring signal for determining a reflection coefficient from said measuring signal;

25 wherein the apparatus comprises a lens (309) common to the illumination unit and the observation unit;

characterized in

30 that said lens is arranged so that said illumination beam and said observation beam form an overlap therein; and

that said first observation field stop (310) comprises a wall member extending from the observation light receiver towards said lens; wherein the wall member extends only a part of the distance between the observation light receiver and the lens as to limit said ray boundary of said observation beam while maintaining said overlap of said illumination beam and said observation beam inside the lens.

10 2. The apparatus according to claim 1, comprising a second observation field stop (308) between the observation light receiver and the lens and displaced along the direction of propagation of said observation beam from the first observation field stop.

15

3. The apparatus according to claim 1 or 2, wherein said illumination unit comprises:

20 (a) an illumination light source, said illumination light source comprising at least one light source (301) and an illumination aperture stop (303), said at least one light source and said illumination aperture stop being arranged to provide a confined luminous field,

25 (b) an illumination field stop (307), said illumination field stop being adapted to provide an illumination beam (305) of light from said confined luminous field,

30 (c) an collimating optical element (309), said collimating optical element being adapted to collimate said illumination beam and to provide an illumination field (313) on an object;

wherein said observation unit comprises:

(a) at least a first observation field stop (310),
said at least one observation field stop being adapted
5 to provide an observation beam (306) of light from an
observation field (314) on said object, said observa-
tion beam comprising a ray boundary,

(b) at least one focusing optical element (309), said
10 at least one focusing optical element being adapted to
focus said observation beam,

wherein the observation light receiver comprises a
light receiver (302) and an observation aperture stop
15 (304), said light receiver and said observation
aperture stop being arranged to provide a confined
receiving field of said focused observation beam;

wherein said first observation field stop is adapted to
20 stop light from said illumination unit in reaching said
observation light receiver of said observation unit.

4. The apparatus according to any one of claims 1 through
3, wherein said first observation field stop (310)
25 extends substantially half the distance between the
observation light receiver and the lens.

5. The apparatus according to any one of claims 1 through
4, wherein said first observation field stop is adapted
30 to stop light reflections.

6. The apparatus according to any one of claims 3 to 5
wherein said collimating optical element (309) and said

focusing optical element (309) are accommodated in said lens (309).

7. The apparatus according to any one of claims 3 to 6
5 wherein said collimating optical element (409) has an optical axis which is displaced relative to the optical axis of said observation aperture stop (304).

8. The apparatus according to any one of claims 3 to 6
10 wherein said collimating optical element (409) is tilted so that its optical axis is non-parallel to the optical axis of the said observation aperture stop (404).

9. The apparatus according to any one of claims 1 to 8
15 wherein said illumination field stop (307) is fixed to said wall member.

10. The apparatus according to any one of claims 3 to 9
20 further comprising a directional optical element (311) for lateral direction of said collimated illumination beam.

11. The apparatus according to any one of claims 3 to 10
25 wherein said collimating optical element, said focusing element, said common optical element, and said directional optical element are selected from the group consisting of refractive optical elements, reflective optical elements, and diffractive optical elements, or a combination thereof.

30

12. The apparatus according to claim 11 wherein said refractive optical element is a lens, lens assembly, prism, or a combination thereof.

13. The apparatus according to claim 11 wherein said reflective optical elements is a mirror, preferably a planar mirror or a non-planar mirror, or a combination thereof.

5

14. The apparatus according to claim 11 wherein said diffractive optical elements is a hologram.

15. The apparatus according to claim 11 wherein said collimating optical element, said focusing element, said common optical element, and said directional optical element are accommodated in single element, said single element comprising a concave mirror, non-planar prism, or a hologram, or a combination thereof.

15

16. A diffuser light-source assembly, the assembly comprising:

(A) a light source (515); and

20

(B) a diffuser (516) with a cavity wall, said diffuser comprising:

(a) a diffusive reflecting cavity wall, said diffusive reflecting cavity wall comprising partly or wholly reflective surface elements, providing multiple reflections of said light received through a light receiving aperture, and

(b) a plurality of light emitting apertures (517), said light emitting apertures being arranged in said cavity wall

characterized in that said light emitting apertures are adapted to emit diffused light.

17. The assembly according to claim 16 wherein said light
5 emitting apertures constituting less than 20%, preferable less than 10%, in particular 3% to 5% of said cavity wall.

18. The assembly according to claims 16 or 17 wherein
10 said diffuser cavity wall comprises a light receiving aperture (518) said light receiving aperture being adapted to receive light from said light source.

19. The assembly according to any one of claims 16-18
15 wherein said reflective surface comprises a white finish applied to interior walls thereof.

20. The assembly according to any one of claims 16-19
20 wherein said diffuser comprises a longitudinally extending cavity having a rectangular cross section, said cavity comprising an end face accommodating said light receiving aperture (518), and a bottom face accommodating said plurality of light emitting apertures (517).

21. The assembly according to any one of claims 16-20
25 wherein said cavity wall comprising said plurality of light emitting apertures (517) consist of a thin perforated plate; the thickness of said plate being selected so that conditions of diffused light is maintained.

30

22. An apparatus for measuring light reflections of an object, the apparatus comprising:

(a) a housing;

(b) a light-source illumination-observation assembly (601-610) as defined in claims 3-15 incorporated in said housing.

5 23. The apparatus according to claim 22 further comprising a diffuser light-source assembly (614,615) as defined in claims 16-21.

10 24. The apparatus according to claim 22 or 23 further comprising means for determining a retroreflection coefficient and/or a reflection coefficient of the measured light reflections of the object.

15 25. The apparatus according to any one of claims 23-24 further comprising means for selecting a light source between said light source illumination-observation assembly and said diffuser light-source assembly.

20 26. Use of an apparatus according to any one of claims 22-25 for measuring light retroreflection, light reflection, or both.

25 27. Use according to claim 26 wherein the object is a reflective material, a reflective device, a retroreflector material, and a retroreflector device, or a combination thereof, in particular a road marking, a road surface, a raised pavement marking, or all.

30